(12) UK Patent Application (19) GB (11) 2 156 069 A

(43) Application published 2 Oct 1985

(21) Application No 8502586

(22) Date of filing 1 Feb 1985

(30) Priority data
(31) 84/014294 (32) 3 Feb 1984 (33) JP
84/014295 3 Feb 1984

(51) INT CL⁴
G11B 7/08

(52) Domestic classification
G1A A3 C12 D10 EE G1 G2 G7 G8 R7 S4 T14 T26 T3 T4 T8
U1S 2108 2148 G1A

(56) Documents cited
GB A 2083252 GB 1515177 GB 1435922

(58) Field of search
G1A

(71) Applicant
Pioneer Electronic Corporation (Japan),
No 4–1 Meguro 1-chome, Meguro-ku, Tokyo, Japan

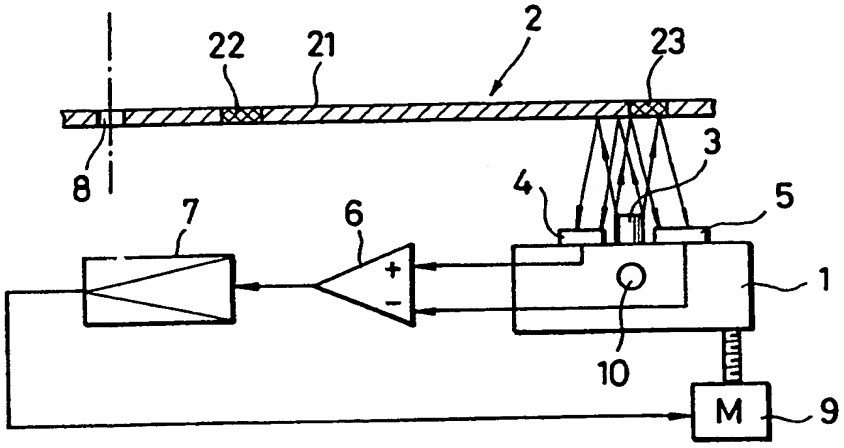
(72) Inventor
Hitoshi Kanamaru

(74) Agent and/or Address for Service
Gill Jennings & Every,
53–64 Chancery Lane, London WC2A 1HN

(54) Apparatus for reproducing recorded information

(57) An apparatus for reproducing recorded information from an optical disk wherein the angular relationship between the surface plane of the disk 2 and the optical axis of the reading beam is controlled so as to minimize the amount of cross talk. The amount of deviation from 90° is detected, and a servo 6, 7, 9 system employed to adjust the angle accordingly. The radius of the beam of light from an emitter 3 on the surface of the disk is made smaller than the width in radial length of lead-in and lead-out portions 22, 23 of the disk. Preferably, disk irradiating positions of the recorded information-reading beam and the tilt-detecting beam are on the same track of the disk.

FIG. 1



GB 2 156 069 A

FIG. 1

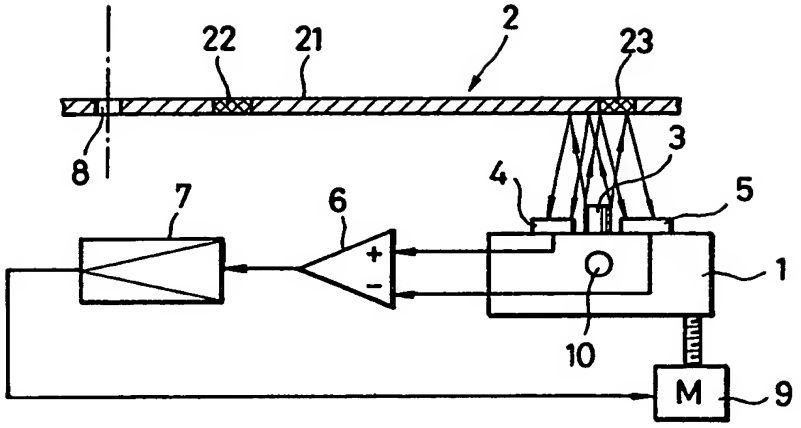


FIG. 2A

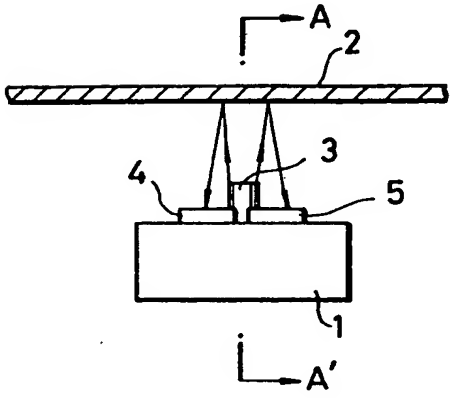


FIG. 2B

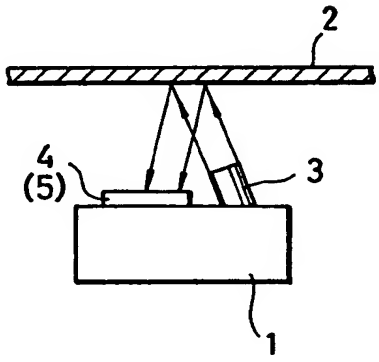


FIG. 3

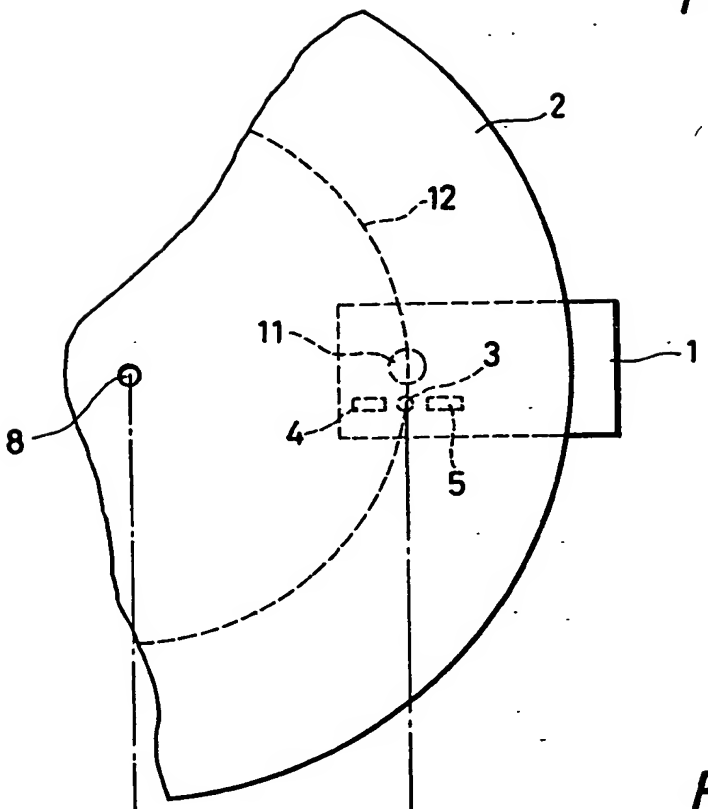
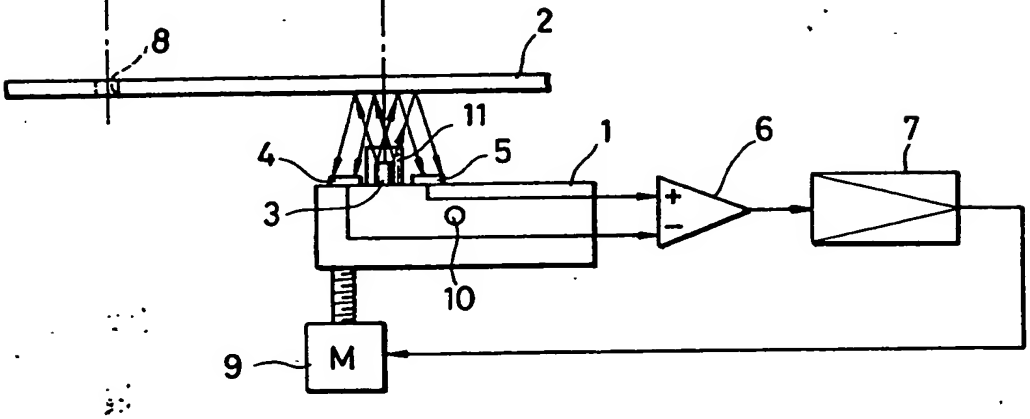


FIG. 4



SPECIFICATION

Apparatus for reproducing recorded information

The present invention relations to an apparatus for optically reproducing recorded information which employs a so-called "tilt" servo by which the angle between the surface plane of a recorded disk and the optical axis of a light beam for reading information recorded on the disk is held at 90°.

If the angle formed between the surface plane of a recorded disk and the optical axis of a light beam for reading information recorded thereon deviates significantly from 90°, information from an adjacent recorded track leaks into the detection signal and cross talk occurs. A tilt servo system is therefore provided for reducing such cross talk by maintaining a 90° relationship between the surface plane of the disk and the optical axis of the information-reading beam.

This servo system includes a detector for detecting any deviation from 90° of the angle between the surface plane of the disk and the optical axis, and a tilting unit for adjusting this angle in accordance with the output of the detector. This detector includes a light-emitting element for providing a beam of light applied to the surface of the recorded disk and a pair of light-detecting elements disposed on either side of the light-emitting element so as to receive the light reflected from the disk. The servo system controls the beam angle on the basis of the difference in the outputs of the received beams.

The detector is located in the vicinity of the optical axis of the information-reading light beam for properly detecting the angular relationship between the disk and the optical axis of the information-readinf light beam. However, since there is a difference between the reflectivity at the portions including the inner and outer peripheral portions of a disk, and areas where tracks (pits) are present and at the portions where no tracks are present, a difference in the amount of reflected light incident upon the light-detecting elements occurs, thereby giving rise to a malfunctioning of the servo system.

Accordingly, an object of the present invention is to provide an apparatus for reproducing recorded information which is capable of generating accurate tilt servo signals at both inner and outer peripheral portions of a disk.

The invention provides an apparatus for reproducing recorded information in which the diameter of a light beam used for detecting recorded infomation is established at such a value as to make the servo signals accurate over the entire face of the disk.

More specifically, an apparatus for reproducing recorded information according to the present invention includes a servo system wherein the amount of deviation from 90° of an angle formed between the surface of a recorded disk and the optical axis of a light beam for detecting recorded information is detected, and tilting means for controlling the tilt angle of beam generating means is controlled so as to maintain the right-angle relationship. The means for detecting the right-angle relationship comprises the light beam generating means for applying a beam of light to the recorded disk surface, and light-detecting means receiving light reflected from the recorded disk surface, wherein the diameter, and preferably the radius, of the emitted beam of light on the disk surface is set to be smaller than the smaller in radial length of the lead-in and lead-out portions of the disk. Preferably, the disk irradiating positions of the recorded information detecting beam and the emitted light beam are on the same track on the surface of the disk.

Some examples of apparatus constructed in accordance with the invention are illustrated in the accompanying drawings, in which:—

Figure 2 is a diagram illustrating a first example;

Figures 2A and 2B are diagrams illustrating another example, of which Fig. 2A is a side-elevational view and Fig. 2B is a cross-sectional veiw taken along the line A–A′ in Fig. 2A;

Figure 3 is a top plan view of another example; and,

Figure 4 is a block diagram including a side-elevational view of the apparatus shown in Fig. 3.

In the Fig. 1 arrangement, on a pickup 1 there are provided a light-emitting element 3 for detecting the angular relationship between the surface of a disk 2 and the optical axis of a light beam (not shown) for reading recorded information, and light-detecting elements 4 and 5 disposed on opposite sides of the element 3. Light emitted by the element 3 and reflected from the disk surface is received by the elements 4 and 5. The outputs from both elements 4 and 5 are inputted into a differential amplifier 6, and the output thereof applied to drive a tilt servo motor 9 by means of a servo amplifier 7. This motor 9, in turn causes the pickup 1 to rotate with the axis 10 as its centre so as to control the inclination of the optical axis of the information-reading beam.

If the disk 2 tilts, resulting in a deviation from a right-angle relationship, a difference occurs in the output of the light-detecting elements 4 and 5. A signal corresponding to the amount of this deviation is obtained from the output of the differential amplifier 6, and this signal serves as a servo signal for controlling the motor so as to maintain the right-angle relationship.

On the other hand, in lead-in and lead-out tracks, there is recorded various information,

such as CLV (constant linear velocity), CAV (constant angular velocity) and CAA (constant angular acceleration) signals needed to read out subsequent information without fail. Thus, the minimum regions for the lead-in and lead-out tracks must be strictly determined.

According to the laservision standards of optical laser disks, there are provided around the outer peripheral surface of the disk 2 a lead-out track 23 extending about 1 mm in the radial direction of the disk on the periphery of the surface leading from the completion point of a program 21, as well as a lead-in track 22 extending about 1.5 mm in the radial direction of the disk on the inner periphery of the surface adjacent to the starting point of a program 21 on the inner peripheral portion of the disk. Reference numeral 8 indicates the centre of rotation of the disk.

If a radius smaller than 1 mm were selected as the radius of the light beam emitted from the element 3, when the recorded information-reading beam arrives at the inner or outer peripheral surace of the disk, the beam would fail to be applied to the portions of the disk not provided with pits, with the result that no difference occurs in the amount of reflected light received by the light-detecting elements 4 and 5. Consequently, it is possible to effect accurate operations of the tilt servo even on the inner and out peripheral portions of the disk.

Furthermore, if this detected inclined beam comprises a pair of parallel luminous fluxes, it is possible to eliminate errors in detection and a reduction in the detection sensitivity at the upper and lower positions of the disk.

Figs. 2A and 2B shown another arrangement and portions that are identical with those shown in Fig. 1 are indicated by the same reference numerals. Fig. 2A is a side-elevational view, while Fig. 2B is a cross-sectional view taken along a line A–A in Fig. 2A. In this embodiment, if the light-emitting element 3 is disposed such as to be tilted in the direction tangential to the track as shown in Fig. 2B and in the plane which intersects the latter at a right angle as shown in Fig. 2A, the major portion of the reflected light is incident upon the light-receiving surfaces of the light-detecting elements 4 and 5 so that it is possible to obtain a tilt servo signal efficiently and withour error. If the light-detecting elements 4 and 5 are provided in the form of an elongate structure extending along the tilt direction of the element 3, it is possible to eliminate errors resulting the variation in the upper and lower positions of the disk.

Since the radius of the tilt-detecting light beam on the disk is set to a radius smaller than the radial length of the lead-in and lead-out portions, the tilt-detecting beam does not deviate from the pits even at the inner and outer peripheral portions of the disk, and accurate operation of the tilt servo can thus always be effected.

Figs. 3 and 4 shows another arrangement. Fig. 3 is a top plan view illustrating the positional relationship between the pickup 1 and the disk 2, while Fig. 4 is a block diagram including a side elevational view of the apparatus shown in Fig. 3. In these figures, reference numerals employed commonly in Figs. 1, 2A and 2B denote like components, and further detailed descriptions thereof will be omitted.

In this case, the information-reading beam is converged and applied to the disk 2 by means of an objective lens 11, and the disk-irradiating positions of this beam and the tilt-detecting beam of the light-emitting element 3 are adjacent to each other and on the same track on the surface of the disk. In this way, although the radiating positions of both beams occupy different positions with respect to the radial direction of the disk, it is possible to effect accurate operation of the tilt servo by virtue of such postional relationship of irradiation since, in light of the objective of eliminating cross talk, it is necessary to detect the disk tilt of the recording track portion which is presently being traced by the information-reading beam and to compensate for this deviation.

Since the disk-irradiating positions of the information-reading light beam and the tilt-detecting light beam are set on the same track on the surface of the disk, it is possible to detect accurately the tilt of the track portion presently being traced by the information-reading beam, and the detecting position does not deviate from the outer periphery of the disk, with the result that accurate operation of the tilt servo can be effected.

CLAIMS

1. An apparatus for reproducing recorded information with a servo system for detecting and correcting deviations from 90° of an angle between a recorded disk surface and an optical axis of a light beam for reading recorded information; the apparatus comprising means for detecting the angle and tilting means for tilting the optical axis in accordance with the deviation so as to maintain the angle at 90°; the means for detecting the angle comprising light-emitting means for applying a beam of light to the recorded disk surface, and light-detecting means for receiving light reflected from the recorded disk surface, wherein the radius of the beam of light incident on the disk surface is smaller than the radial dimension of lead-in and lead-out portions of the disk.

2. Apparatus according to claim 1, wherein the beam comprises a pair of parallel luminous fluxes.

3. Apparatus according to claim 1, wherein the beam comprises a luminous flux having an optical axis included in a plane

intersecting a track of the disk and tilted in the plane.

4. Apparatus according to any one of the preceding claims, wherein the beam has a radius smaller than 1 mm.

5. Apparatus according to any one of the preceding claims, wherein the tilting means comprises a differential amplifier, a servo amplifier and a servo motor.

6. Apparatus according to any one of the preceding claims, wherein disk irradiating positions of the recorded information-reading beam and the applied light beam are on the same track of the disk.

7. An apparatus for reproducing recorded information with a servo system for detecting and correcting deviations from 90° of an angle between a recorded disk surface and an optical axis of a light beam for reading recorded information; the aparatus comprising means for detecting the angle and tilting means for tilting the optical axis in accordance with the deviation so as to maintain the angle at 90°; the means for detecting the angle comprising light-emitting means for applying a beam of light to the recorded disk surface, and light-detecting means for receiving light reflected from the recorded disk surface, wherein disk irradiating positions of the recorded information-detecting beam and the applied light beam are on the same track of the disk.

8. An apparatus for reproducing recorded information, substantially as described with reference to any one of the examples illustrated in the accompanying drawings.

Printed in the United Kingdom for
Her Majesty's Stationery Office, Dd 8818935, 1985, 4235.
Published at The Patent Office, 25 Southampton Buildings,
London, WC2A 1AY, from which copies may be obtained.